

**ON FIVE NEW SPECIES OF BDELLOID ROTIFERA.**

BY DAVID BRYCE.

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PLATES 8 &amp; 9.

THE five species of which descriptions are furnished in the present paper have been known as distinct forms for many years past, although their distinguishing characteristics have not hitherto been gathered into the formal diagnosis which constitutes scientific baptism. Four of them belong to that important section of the Philodinidae in which the food is formed into pellets after passing through the mastax, and are assigned to the genus *Habrotrocha*. The fifth species belongs to the more numerous section of the same family in which the food is not at any time agglutinated into pellets, and being oviparous and possessed of three toes is a member of the genus *Callidina*, as now restricted.

Under the name of *Habrotrocha munda*, I describe the form to which I referred in some remarks upon the identity of *Callidina elegans* Ehrbg., appended to my paper on "A New Classification of the Bdelloid Rotifera,"\* as having been wrongly identified as that species by Hudson and Gosse and by other writers. I have endeavoured in that place to show as clearly as possible my reasons for the belief that this form cannot be that which Ehrenberg described; and inasmuch as none of the various correspondents who have addressed me with regard to my classification have advanced a view contrary to my own in this matter, I think that this victim of mistaken identity may now be established on a firmer and less assailable basis.

This species is the most common of the few pellet-making forms which have their usual habitat in ponds and ditches. In fresh gatherings it may frequently be seen swimming vigorously with its head slightly deflexed, or perhaps marching about at a great

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pace, and will often attract attention from the bright reddish colour of the stomach wall. On closer examination it may be readily recognised from the peculiar shape and pose of the spurs, which are quite distinctive, and from the many-toothed rami. Under more natural conditions, it takes shelter in any convenient recess among debris or in leaf axils, and there makes its home, protruding the head and neck when it desires to feed.

The second species, *Habrotrocha torquata*, has similar many-toothed rami, but in several other respects differs distinctly from *H. munda*. I believe that in some quarters it has also been accepted as *Callidina elegans* Ehrbg., probably on account of the rami. Unlike *H. munda*, it is never found in ditches or ponds, but has its habitat usually in mosses growing in positions frequently wet. The spurs are of simple form and the stomach wall is never of reddish tint. It has not been observed to seclude itself in any way and is of comparatively quiet habit. Its specific name was suggested by a curious but illusory appearance in some positions of an annulus encircling the expanded corona.

The third of the pellet-making species, *Habrotrocha spicula*, is a rather smaller form, which has the, so far, unique distinction of a single spine of small size placed on the pre-anal segment on the median dorsal line. When the body is contracted, or when the animal is seen in lateral view, this spine is sufficiently obvious, but at other times it is most easily overlooked. In my own experience this Bdelloid has only occurred in hilly country in elevated positions, but I learn from Mr. James Murray that he has also met with it in lowland habitats.

The fourth species, *Habrotrocha ligula*, is one of those puzzling forms which can only be recognised with certainty when it is feeding. It is mainly distinguished by the possession of a small fleshy tooth, which stands erect in front of the narrow sulcus between the two pedicels of the corona, difficult to discern except in direct dorsal view. In other respects it offers little to remark.

For my earliest knowledge of the new Callidina, I am indebted to my esteemed correspondent the late Forstmeister L. Bilfinger,

of Stuttgart, who sent to me, as long ago as 1894, a sketch of the animal together with some moss in which it occurred. I have therefore given it the specific name *Bilfingeri*, in honour and in grateful appreciation of a most courteous correspondent and of a painstaking and careful observer of the Rotifera. The type form of this species is marked by a series of lateral and dorsal knob-like prominences on the posterior half of the trunk. As in most other species with such knobs or with spines, the presence of these ornaments is not constant, and occasional examples are found in which some or even all the typical prominences are absent.

**Habrotrocha munda** sp. nov. (Pl. 8, fig. 1).

*Specific Characters.*—Corona moderately wide, exceeding collar; pedicels with dorsal inclination; discs more strongly inclined in same direction. Under lip relatively high, centrally prominent and spoutlike. Dorsal antenna long. Rami with seven or more fine teeth. First foot joint with dorsal prominence. Spurs resembling caudal processes of *Chaetonotus*.

In general build and in the somewhat "smothered" appearance of the corona, due in this case to the shortness of the pedicels and to the very oblique setting upon them of the trochal discs, this species has a certain resemblance to *Habrotrocha torquata*, but can usually be distinguished from it by the shape of the spurs, which in typical specimens have a very characteristic moulding and pose. In the normal or extended position, the body is spindle-shaped, distinctly larger about or a little behind the centre, and smaller at either extremity, and rarely exceeds 320  $\mu$  in length. While the rostrum is shorter and thicker than usual, the head and neck are only moderately stout, the trunk being distinctly larger (sometimes almost swollen when well fed), the lumbar segments short and tapering rapidly to a relatively small and slender foot of (I think) three segments. When creeping, the dorsal and lateral longitudinal skin-folds are usually well marked. In adult examples the stomach wall is frequently of a vivid reddish colour, and the lumen of the stomach is usually crammed

with obvious food pellets. The first foot segment has a median dorsal prominence of moderate height, rather wider than long, and best seen in lateral view. The second segment has the very characteristic spurs, which always suggest to me the caudal processes of the common form of *Chaetonotus*. They are longer than is customary among pellet-making species, frequently measuring 14 to 15  $\mu$  in length, but are sometimes much shorter. Near the base they are swollen on the inner side, and closely approximate. About mid-length they suddenly diminish in thickness and are thence produced to rather acute points. The outer side of each is nearly straight, and they are held at a slightly divergent angle. The three toes are difficult to see, but the terminal pair (and I think the dorsal toe as well) are moderately long and acute. The dorsal antenna is sometimes quite 25  $\mu$  long and is carried much as in *Rotifer macroceros*, being inclined backwards when the animal is creeping about, and directed more or less forward when it is feeding.

The corona attains a width of about 45  $\mu$ . The trochal discs are separated by a shallow furrow, which narrows to a mere notch as it nears the ventral side. On that side accordingly the principal wreath is almost uninterrupted, and in place of the customary appearance in front view of two distinct "wheels" there is rather that of a toothed band passing rapidly round a single transversely elliptic course, distinctly broken on the dorsal side and only slightly indented on the ventral. In lateral view it is seen that the pedicels are dorsally inclined, short and obliquely truncate, so that the trochal discs are still more inclined towards the dorsal side. The under lip and mouth margins are high in relation to the discs, and the former centrally prominent and spout-like as in *Habrotrocha angusticollis*, but in a lesser degree. The upper lip is usually hidden by the reverted rostrum. So far as I have been able to discern, it rises moderately towards the centre and is neither bilobed nor reflexed. The rami are about 19  $\mu$  in length, somewhat triangular in outline, and have each at least seven very fine teeth.

*Habrotrocha munda* occurs most frequently in pools, especially when water-mosses and anacharis are present. I have also found it occasionally in sphagnum and in confervae, both in floating masses and in the growth upon submerged stones. In suitable situations it makes for itself a rough case or nest of the same type as that produced by *Rotifer macroceros*.

It is of cosmopolitan distribution. I have noted it for England, Scotland, Germany (Baden, Black Forest, Wurtemberg, Stuttgart), Cape Colony.

### ***Habrotrocha torquata* sp. nov. (Pl. 8, fig. 2).**

*Specific Characters.*—Of medium size and stoutness. Corona equal to or rather exceeding collar; pedicels short, distinct; trochal discs more or less dorsally inclined. Upper lip moderately high, undivided but centrally slightly reflexed; under lip unusually high, yet scarcely prominent. Dorsal antenna rather long. Rami with six or more fine teeth. Spurs short, divergent, conical.

When creeping about, *H. torquata* is somewhat difficult to recognise, as it lacks any conspicuous peculiarities of form, colour or size. It is perhaps most usefully described by comparison with other species of the same genus having similar many-toothed rami. The body is of moderate dimensions, less spindle-shaped than in *H. munda*, but less parallel-sided than in *H. elegans* (Milne). The rather short foot is longer and more distinct than in the latter species, but is less so than in *H. constricta* (Duj.). The spurs are simple short cones of moderate stoutness, and are held at almost a right angle, differing thus from the slighter and widely divergent spurs of *H. constricta*, the short, peg-like, very slightly divergent spurs of *H. elegans* (Milne) and the comparatively long moulded spurs of *H. munda*. In most examples the stomach is not obviously tinted, but is occasionally of a yellowish colour, yet never of the reddish shade frequent in *H. munda*, *H. auriculata*, and other species.

In habit it resembles *H. constricta*; that is to say, it lives in the

open and is not a dweller in the shelter afforded by natural or contrived gatherings of dirt particles or debris like *H. elegans* (Milne) and *H. munda*. I have never met with it in pools, but usually in mosses (not sphagnum) growing in wet positions. When the corona is displayed, it is seen to have a quite unusual appearance. As in *H. munda*, the trochal discs are inclined towards the dorsal side, but in a varying degree, and are separated by a furrow deeper than in that species. The upper lip rises in a broad rounded lobe which is centrally bent back, leaving visible the fleshy connection, or nexus, between the short pedicels. On the ventral side the under lip rises unusually high, and thus in dorsal view, the collar, which passes round the pedicels on either side and merges gradually into the under lip, has an obliquely upward direction, not obliquely downward as customary. This results in the optical presentments of the rapidly beating cilia of the secondary wreath (those lining the collar and passing round to the mouth), and of the cilia of the principal wreath (those of the trochal discs), being to some extent commingled, and there is the appearance of an annulus or ring passing round the trochal discs immediately below their margins. When the discs are seen so that their planes are nearly coincident with the line of sight, they appear to have deeply grooved margins, but the exact appearance varies with the angle at which they are viewed. Whether the appearance be that of a ring or of discs with deeply grooved margins, it is in my opinion purely an optical effect arising from the mutual interference of the light rays from the two wreaths of cilia.

The high under lip is unusually flat and inconspicuous; the lateral margins of the mouth are scarcely thickened and the mouth cavity is small as compared with that of other Philodinidae. When feeding the lumbar plicae are well marked.

The foot represents about one-ninth of the total length. It has four joints, the first having dorsally a distinct thickening of the hypodermis.

In the confinement of a small cell *H. torquata* proved only

moderately hardy. After a few days, most specimens would feed freely under the unaccustomed light and would remain quiet, but I have never known eggs to be laid under such conditions.

By no means a common species, yet widely distributed; I noted it first in moss sent me in 1895 by Forstmeister L. Bilfinger, of Stuttgart. I have since found it in moss from Epping Forest, Essex; Chagford, Devon; Pass of Leny, Perthshire; Black Forest, Baden.

*Dimensions*.—Greatest length  $410\ \mu$ , more frequently  $320$  to  $350\ \mu$ . Corona  $38$  to  $41\ \mu$ . Rami about  $15\ \mu$ . Spurs  $6$  to  $9\ \mu$ .

**Habrotrocha spicula** sp. nov. (Pl. 9, fig. 1).

*Specific Characters*.—A single, short, blunt spine, sub-erect upon dorsal median line of pre-anal segment. Corona small,  $13$ – $18\ \mu$  wide; pedicels adnate; upper lip high, rounded, undivided. Rami with four teeth each. Spurs, short cones, widely separated.

A rather small species, chiefly noteworthy for the solitary spine and its unusual position. No other Bdelloid yet known has only a single spine or has spines only upon the pre-anal segment as in this case. When the animal is in its most retracted position, as one usually sees it lying inert among moss debris, the spine stands out distinctly at the hinder end of the body, and it is also well shown when the animal is feeding and assumes the squatting position natural to many species. It is easily overlooked when the animal is crawling about unless a good side-view is presented. It springs from a thickened base, and is rather blunt, short and slightly bent.

When seen from the front the very small corona is nearly circular in outline, the trochal discs being separated by a shallow furrow and the pedicels adnate. In dorsal view the high rounded upper lip rises quite to the level of the trochal discs, and its apex indeed is visible in ventral view. The margins of the mouth have small angular lateral prominences, which are partly

visible even from the dorsal side and add to the apparent width of the collar.

When extended the body is moderately stout and the longitudinal skin-folds are well marked. In most cases it is colourless, but examples of a faintly reddish colour have been seen. The antenna is short, but rather stout. The rami are small, 14-15  $\mu$  long.

The foot tapers rapidly and is very short. In the feeding position it is usually hidden beneath the trunk. It seems unsuited for crawling on a smooth surface such as glass, as the animals have unusual difficulty in getting foothold. The first joint has frequently a strong protuberance on its dorsal side. The spurs are very small cones about 3  $\mu$  long separated by an interspace about 6  $\mu$  wide.

The largest examples measured were about 200  $\mu$  long when extended, but others were from 170 to 185  $\mu$ . My earliest specimens were found in mosses collected for me on Cader Idris by Mr. D. J. Scourfield in 1895. Others came from collections on Mickle Fell and on Snowdon by the same friend. In 1898 I found it in moss from the top of Ben Ledi, in 1907 from the top of Ben Vrackie, both in Perthshire; and in 1906 from tree-moss in the woods above Triberg in the Black Forest, Baden. It has also been found repeatedly by Mr. James Murray in Scotland and in many foreign habitats.

Distribution : cosmopolitan, mostly at high elevations.

Habitat : ground, rock or tree-mosses.

### *Habrotrocha ligula* sp. nov. (Pl. 9, fig. 2).

*Specific Characters.*—Moderately slender. Corona somewhat wider than collar; pedicels rather high, semi-adnate; discs separated by narrow sulcus. Upper lip rising very slightly and displaying a small fleshy tooth, which near its apex tapers suddenly to a point. Rami with four teeth each. Foot three-jointed; spurs small, tapering cones with interspace nearly equal to their length.



A species of rather less than medium size which in its extended position offers no obvious character for its recognition. The rostrum is short and stout, and the dorsal surface has a distinct almost ridge-like thickening of the hypodermis, best seen in lateral view. Its movements are active when crawling about, and when feeding it sways and bends almost incessantly in all directions, the body being well extended and the upper foot joints visible. The trochal discs are rather small and the greatest width of the corona little exceeds that of the collar. The pedicels are adnate to nearly half their height and are very slightly divergent. At the dorsal end of the nexus between them is a small fleshy ligule or tooth, which for the most part is nearly cylindrical, but near the tip tapers rather suddenly to a point. It is so inconspicuous that it can rarely be seen except in direct dorsal view and when the animal keeps steady for a brief interval. Even then the exact shape of the ligule is difficult to determine, but I think that it differs somewhat from the type of ligule possessed by any of the few Bdelloids in which this peculiar ornament or organ has been seen. In *Habrotrocha eremita* (Bryce), in which it was first noted, it is a simple, short, peg-like tooth, very slender and tapering gradually, and, to judge from the figures given by Murray, it appears to be of the same character in *Habrotrocha acornis* Murray and *Callidina lepida* Murray. In the present species the appearance is rather that of a fleshy cylindrical pedestal, with a tapering point inset at the end of the pedestal as if in a socket.

The upper lip rises in a low curve about as high as the base of the ligule. The rami have four teeth, but one tooth on each is much less prominent than the others. I have noticed that the food pellets are rather small. Examples isolated produced eggs of oval outline, hyaline, smooth-shelled, measuring  $70 \mu$  at the longest by  $43 \mu$  at the shortest diameter.

I had this species first in 1894 from a roadside near Deal, and in the following year from a wall in Bognor; in both cases from small button-like tufts of wall-moss. I did not see it again until

some few weeks ago, when it was brought to me by Mr. G. K. Dunstall, who had obtained it from moss collected near Leith Hill, in Surrey. It is probably a more common species than these three isolated records would indicate. It may be that it has a partiality for small tufts of moss (which do not invite examination), or perhaps its restlessness and the absence of any very obvious peculiarity when marching about has led to its being overlooked.

In view of Murray's opinion that the presence of a ligule in Bdelloids is an unsafe specific character, as it often appears in species where it is not normally present, it must be pointed out that, while it may be presumed that the ligule in *Habrotrocha ligula* is fairly constant, it is by no means impossible that examples should occur in which it might be absent, and in that case, if normal specimens were not available for comparison, identification might well be difficult.

*Dimensions*.—Length about 320  $\mu$ . Corona 30  $\mu$ . Collar 25  $\mu$ . Ramus 17  $\mu$ . Spurs 5  $\mu$ .

***Callidina Bilfingeri* sp. nov. (Pl. 9, fig. 3).**

*Specific Characters*.—Of medium size, and moderately stout, posterior trunk having a series of knob-like prominences. Trochal discs well separated, but corona not exceeding collar width. Upper lip rather high and wide, with shallow central depression. Rami with two teeth each. Dorsal antenna short, about half the neck thickness. Foot three-jointed; first joint laterally swollen, second very short, somewhat distended to form sucker-like disc. Spurs very minute cones, with wide, slightly convex interspace.

So far as I am aware, this rather well-marked species, of moderately stout build and medium size, has been met with only in ground-mosses. Typical specimens are easily recognised from the series of knob-like prominences which ornament the sides of the trunk segments and the dorsal surface of the rump segments.

The number of these "knobs" appears to be very inconstant, as in sketches made by Forstmeister Bilfinger, James Murray, and myself it varies from eleven to five; and I was informed by the first-named correspondent that he had met with examples without any knobs at all. In such cases the species can still be determined with moderate certainty from the peculiar structure of the second foot joint, and the minuteness and wide separation of the spurs. When the full number of prominences are present they are distributed thus: the third segment of the trunk (or central portion of the body) has one at either side, close to its anterior boundary; the same segment and the fourth and the sixth have each one at either side near their posterior boundaries; while on the dorsal side of the fifth and sixth segments there are three more, arranged in a triangle (two in front on the fifth and one behind on the sixth segment, the latter on the median line). The fifth segment is moderately swollen laterally. The lateral knobs on the sixth segment (the anal) are more nearly constant than the others. Those most frequently absent are the anterior pair of the third segment.

The first foot joint has distinct lateral swellings, and is perhaps swollen dorsally as well. The second joint is very short, and slightly distended with thickened skin, forming a sucker-like disc from the lower surface of which the three short, broad toes are protrusible. The flange-like hinder margin of this foot disc forms the slightly convex interspace between two very minute spurs.

When creeping about the animal is seen to have a short and stout rostrum. In the feeding position the body is somewhat flattened, and the dorsal longitudinal skin-folds are obliterated. The trochal discs are well separated, but the head is stout and the corona does not exceed the collar width. The upper lip rises rather widely and high, and has a shallow central depression. The rami are 14 to 16  $\mu$  long, and are widest above the middle. The anterior outer margin of each is distinctly thickened, and passes gradually into a delicate winglike expansion of the ramus.

As already stated, this species was first discovered by the late Forstmeister L. Bilfinger in the vicinity of Stuttgart, and notified to me in 1894. It was afterwards found by Mr. George Western, probably near London, and in 1904 by James Murray, near Fort Augustus. In 1906 I met with it in moss gathered on the bank of a roadside ditch near Triberg, in the Black Forest. Quite recently numerous examples have been found in moss collected by Mr. G. K. Dunstall near Leith Hill, Surrey.

*Dimensions.*—Length about 315  $\mu$ . Corona 38  $\mu$ . Collar 41  $\mu$ . Spurs 1 to 2  $\mu$  (on inner edge).

## DESCRIPTION OF PLATES 8 AND 9.

## Plate 8.

- Fig. 1. *Habrotrocha munda* sp. nov., extended, dorsal view,  $\times 350$ ;  
 1a, head and neck, corona displayed, in lateral view,  
 $\times 650$ ; 1b, the same, in ventral view,  $\times 750$ ; 1c,  
 mouth, in front view (diagrammatic).  
 ,, 2. *Habrotrocha torquata* sp. nov. In feeding position, corona  
 displayed, dorsal view,  $\times 550$ ; 2a, spurs,  $\times 1600$ .

## Plate 9.

- Fig. 1. *Habrotrocha spicula* sp. nov. In feeding position, corona  
 displayed, ventral view,  $\times 600$ ; 1a, retracted position,  
 $\times 600$ ; 1b, foot extended, dorsal view,  $\times 800$ ; 1c, ramus,  
 $\times 1600$ .  
 ,, 2. *Habrotrocha ligula* sp. nov. In feeding position, corona  
 displayed, dorsal view,  $\times 480$ .  
 ,, 3. *Callidina Bilfingeri* sp. nov. In feeding position, dorsal  
 view,  $\times 350$ ; 3a, ramus,  $\times 1600$ .